



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/607,083	06/27/2003	Toru Kurosaki	030781	5416
23850	7590	02/17/2004	EXAMINER	
ARMSTRONG, KRATZ, QUINTOS, HANSON & BROOKS, LLP 1725 K STREET, NW SUITE 1000 WASHINGTON, DC 20006			TRAN, TAN N	
			ART UNIT	PAPER NUMBER
			2826	

DATE MAILED: 02/17/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

K.S.

Office Action Summary

Application No.

10/607,083

Applicant(s)

KUROSAKI ET AL.

Examiner

TAN N TRAN

Art Unit

2826

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 June 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☒ Claim(s) 11 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 June 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Information Disclosure Statement

1. If applicant is aware of any relevant prior art, he/she requested to cite it on form PTO-1449 in accordance with the guidelines set forth in M.P.E.P.

609.

Specification

2. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Drawings

3. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, an inversion layer as recited in claim 6, a height of the semiconductor filler provided in the inner circumferential groove is higher than that of the remaining portions of the semiconductor fillers in the active grooves as recited in claim 7, the semiconductor substrate includes a drain layer as recited in claim 8, and a collector layer as recited in claim 9 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

Art Unit: 2826

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 8 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The specification does not disclose the semiconductor substrate includes a drain layer as recited in claim 8.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 1-4,6,8 are rejected under 35 U.S.C. 102(a) as being anticipated by Applicant's prior art (APA).

With regard to claim 1, APA discloses a semiconductor substrate 110 including a low concentration layer 112 of a first conductivity type, the semiconductor substrate 110 having grooves formed on its surface on the low concentration layer side, wherein the grooves include a plurality of narrow active grooves (122₁-122₄) and a ring-shaped inner circumferential groove

Art Unit: 2826

130 surrounding the active grooves (122₁-122₄), the bottom faces of the active grooves (122₁-122₄) and a bottom face of the inner circumferential groove 130 are provided in the low concentration layer 112, and both ends of the active grooves (122₁-122₄) are connected to the inner circumferential groove. (Note figs. 37, 38 of APA).

With regard to claim 2, APA discloses a semiconductor filler 155 of a second conductivity type is provided in each of the active grooves (122₁-122₄) and the inner circumferential groove 130, and the semiconductor filler 155 in each of the active grooves (122₁-122₄) is connected to the semiconductor filler 125. (Note figs. 37, 38 of APA).

With regard to claim 3, APA discloses the semiconductor substrate 110 has a plurality of ring-shaped guard ring grooves (123₁-123₃) concentrically surrounding the inner circumferential groove 130. (Note figs. 37, 38 of APA).

With regard to claim 4, APA discloses the semiconductor filler 125 is provided in each of the guard ring grooves (123₁-123₃). (Note figs. 37, 38 of APA).

With regard to claim 6, APA discloses the semiconductor substrate 110 including gate grooves by removing an upper portion of the semiconductor filler in each of active grooves (122₁-122₄), remaining portions corresponding lower portions of the semiconductor fillers 125 situated at lower portions of the gate grooves; a gate insulating film 151 provided at least on a side face of each the gate grooves; gate electrode plugs having a gate electrode 155 provided in contact with the gate insulating film 151 in the gate grooves, being insulated from the remaining portions of the semiconductor filler 125; a base region 133 of a second conductivity type provided on a surface side inside the low concentration layer 112 at a position in contact with the gate insulating film 151; and a source region of a first conductivity type having a source

Art Unit: 2826

electrode 167 provided at position on a surface side inside the base region 133 so as to be separated from the low concentration layer 112 and to be in contact with the gate insulating film 151, wherein when a voltage is applied to the gate electrode plugs having gate electrode 155 to form an inversion layer of the first conductivity type in a portion of a base region 133 in contact with the gate insulating film 151, the source region and the low concentration layer 112 are connected to each other through the inversion layer. (Note lines 22-26, page 4, and lines 1,2, page 5 of applicant's specification; and figs. 37, 38 of APA).

With regard to claim 8, APA discloses the semiconductor substrate 110 includes a N⁺ type semiconductor layer¹¹¹ serves as drain layer wherein a drain electrode 170 forming an ohmic junction with the drain layer is provided on the drain layer. (Note figs. 37, 38 of APA).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 5,7,9,10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's prior art (APA).

With regard to claim 5, APA discloses the inner circumferential groove 130 is formed in a quadrangular ring shape, each of the active grooves (122₁-122₄) is provided in a parallel direction to two parallel sides among four sides of the inner circumferential groove 130. (Note figs. 37, 38 of APA). APA discloses all the claimed subject matter except for the low

Art Unit: 2826

concentration layer has a surface of a plane orientation 100 wherein the 100 plane of crystal of the semiconductor substrate is exposed on a side face and a bottom face inside each of the active grooves and on a side and a bottom face inside the inner circumferential groove. However, it would have been obvious to one of ordinary skill in the art to form the low concentration layer has a surface of a plane orientation 100 wherein the 100 plane of crystal of the semiconductor substrate is exposed on a side face and a bottom face inside each of the active grooves and on a side and a bottom face inside the inner circumferential groove, because such structure is conventional in the art for forming a plurality of the active grooves in the low concentration layer.

With regard to claim 7, APA discloses all the claimed subject matter except for a height of the semiconductor filler provided in the inner circumferential groove is higher than that of the remaining portions of the semiconductor fillers in the active grooves. However, it would have been obvious to one of ordinary skill in the art to form a height of the semiconductor filler provided in the inner circumferential groove is higher than that of the remaining portions of the semiconductor fillers in the active grooves because such structure is conventional in the art for forming a plurality of gate electrodes in the removing the upper portion of the semiconductor filler.

With regard to claim 9, APA discloses all the claimed subject matter except for the semiconductor substrate includes a collector layer of the second conductivity type, forming a PN junction with the low concentration layer, and a collector electrode film forming an ohmic junction with the collector layer is formed on the collector layer. However, it would have been obvious to one of ordinary skill in the art to form the semiconductor substrate includes a

Art Unit: 2826

collector layer of the second conductivity type, forming a PN junction with the low concentration layer, and a collector electrode film forming an ohmic junction with the collector layer is formed on the collector layer because such structure is conventional in the art for forming a plurality of transistors forming the trenches.

With regard to claim 10, APA discloses all the claimed subject matter except for a schottky electrode film forming a schottky junction with the low concentration layer is provided on a surface of the low concentration layer. However, it would have been obvious to one of ordinary skill in the art to form a schottky electrode film forming a schottky junction with the low concentration layer is provided on a surface of the low concentration layer in order to increase the high speed operation. Note (fig. 17 of Omura et al. (6,037,632) teach that the schottky electrode 35 formed on the low concentration layer 32) is cited to support for the well know position.

Allowable Subject Matter

6. Claim 11 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim 11 is allowable over the prior art of record, because none of these references disclose or can be combined to yield the claimed invention such as a schottky electrode forming ohmic junctions with the semiconductor fillers and a schottky junction with the low concentration layer is provided on surfaces of the semiconductor fillers provided in the active

Art Unit: 2826

grooves and on surfaces of parts of the low concentration layer situated between the active groove, in a region surrounded by the inner circumferential groove.

Conclusion

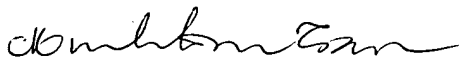
8. Any inquiry concerning this communication or earlier communication from the examiner should be directed to Tan Tran whose telephone number is (571) 272-1923. The examiner can normally be reached on M-F 8:30AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on (703) 308-6601. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for after final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

TT

Jan 2004


Minhloan Tran
Primary Examiner
Art Unit 2826